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COLOR VARIATION IN EASTERN NORTH AMERICAN FLOWERS AS EXEMPLIFIED BY *HEPATICA ACUTILOBA*

EDGAR ANDERSON

THE study of color variation in *Hepatica acutiloba* was undertaken because this species presents marked variation in color and can often be collected in sufficient numbers to give reliable averages. A preliminary report¹ presented data from plants studied along the Narrows of the Big River near Eureka, Missouri. Dr. Ledyard Stebbins very kindly made a census of 191 plants from a maple woods near Hamilton, New York and I personally was able to study 42 plants in a rocky, hardwood forest at Fairlee, Vermont. As in the first communication on the subject, two characters were recorded for each plant, sepal number and flower color.

SEPAL NUMBER. The plants from New York and Vermont had very slightly higher averages for sepal number (7.3 and 6.9 respectively) than did those from Missouri (6.2). Aside from this slight difference in averages, the three collections were remarkably similar in so far as sepal number was concerned. FIGURE 1 demonstrates the similarity of the frequency distributions for the three localities.

FLOWER COLOR. Flower color presented a very different picture from sepal number. There was a pronounced gradient in color and color intensity between Missouri and Vermont, the latter region having a strong tendency to whites and very pale-colored flowers, the former to brighter, stronger colors. Flowers are scored as whites, pinks, and blues. With a little practice this can be done quite reliably. The true whites have no trace of pink or blue in the bud; they have at most a cream or yellowish-green tone. The pinks are sometimes diffi-

¹ Anderson, Edgar. RHODORA 35: 66-67. 1933.

cult if not impossible to distinguish from the whites, when the flowers have opened, but in the bud there is a pronounced flush of pink particularly at the bases and edges of the sepals. Blues and pinks are very easily separated aside from an occasional magenta-flowered plant. These magentas (two or three in all) have been scored with the pinks. The scoring for deepness of color is unfortunately not quite as objective, three classes being recognized, "very faint," "faint," and "deep." Into the first go those flowers which show color only in the bud, being

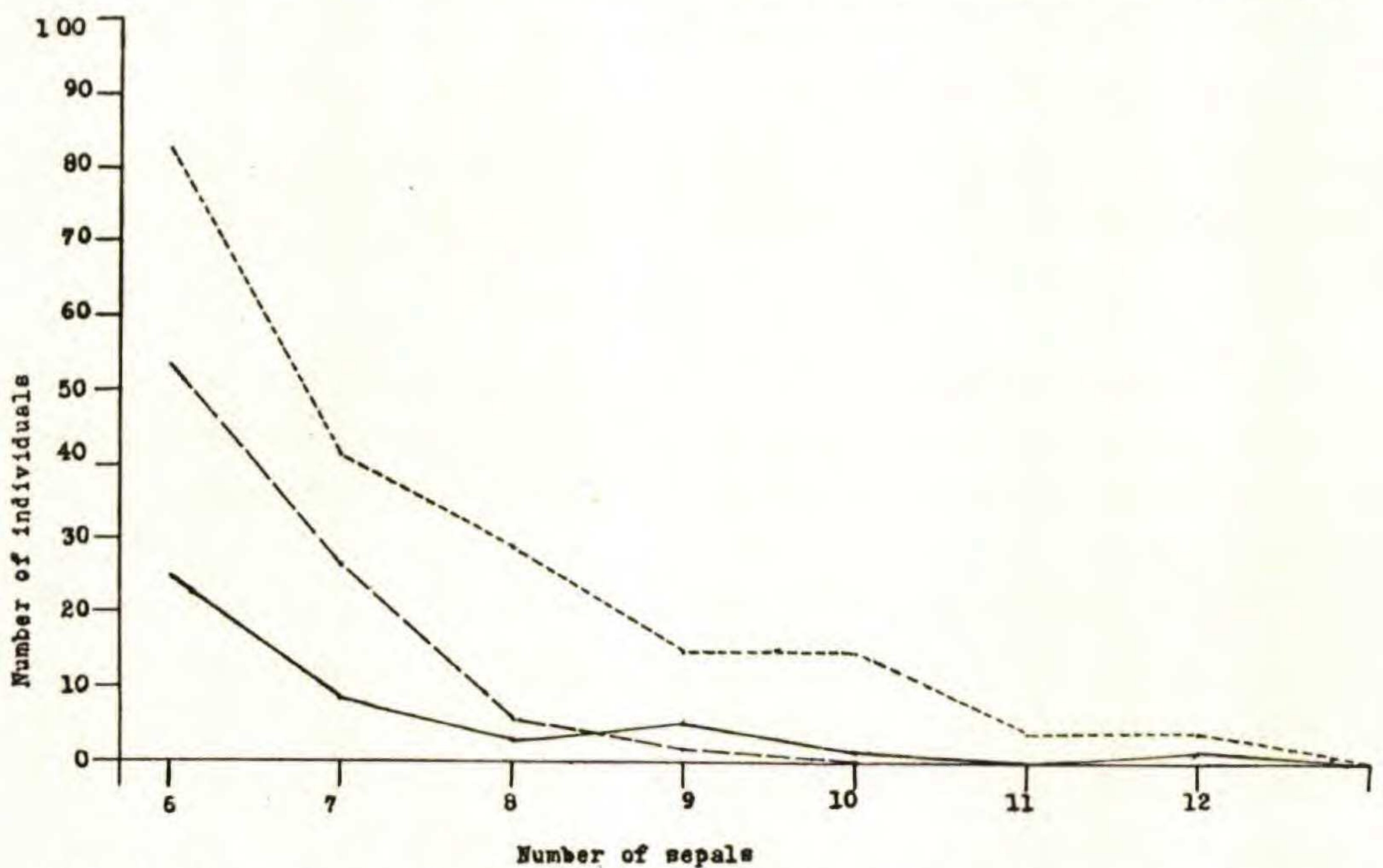


FIG. 1. Variation in Number of Sepals in *Hepatica acutiloba* from Hamilton, New York (dotted line); Eureka, Missouri (dashes); and Fairlee, Vermont (solid line).

practically white when full blown. The division into the remaining two classes is purely subjective.

The data for the three localities are presented in TABLE 1. The actual figures are given as well as percentages, the latter being in brackets. The general geographical trend in flower color from the Ozarks to New England is plainly shown. The percentages of blue, of white and of faint-colored all demonstrate the same tendency. Blue, which in Missouri makes up over a third of the population, falls to less than an eighth in Vermont. White, which, on the other hand, is altogether lacking in Missouri, represents one-sixth of the New York collection and over a third of that from Vermont. The same general tendency is demonstrated, though less objectively, when the figures for percentages of faint color are examined.

NARROWS OF THE BIG RIVER, MISSOURI

	very faint	faint	deep	total
pink	16	24	8	48 [65]
blue	0	13	13	26 [35]
white	0	0	0	0
total	16 [21.6]	37 [50]	21 [28.4]	74

HAMILTON, NEW YORK

	very faint	faint	deep	total
pink	40	49	14	103 [54]
blue	10	23	18	51 [26.7]
white	37	0	0	37 [19.3]
total	87 [45.6]	72 [37.7]	32 [16.7]	191

FAIRLEE, VERMONT

	very faint	faint	deep	total
pink	15	7	0	22 [52.4]
blue	0	4	1	5 [11.9]
white	15	0	0	15 [35.7]
total	30 [71.4]	11 [26.2]	1 [2.4]	42

TABLE 1. Variation in flower color of *HEPATICA ACUTILOBA* from three localities. Figures in brackets are percentages.

The figures for these three collections, therefore, demonstrate a geographical gradient in color between the Green Mountains and the Ozarks for *Hepatica acutiloba*. While further study will be necessary to confirm these results, partial confirmation can be found in the opinions of naturalists familiar with the vernal flora of the two regions. In the opinion of several such naturalists, the results reported above are indicative of a general relationship. The greater brilliance of the spring flora of the Ozarks is not entirely a matter of different species. In several instances, at least, when the same species appears in the spring flora of the two regions, the Ozark form is brighter in color. *Viola pedata* is commonly represented in New England only by the self-colored variety, *Viola pedata* var. *lineariloba*. In the Ozarks the much more brilliant bicolored flowers of the type are found accompanying the self-colored ones of the variety. The flowers of Dutchman's Breeches, *Dicentra Cucullaria* (L.) Bernh., as seen in New England, are usually white or cream-colored. In the Ozarks they are suffused with pink.

Within New England itself there is a tendency towards a greater frequency of white and pale-flowered forms as one approaches the White Mountains. *Cypripedium acaule* Ait., for instance, is bright

pink to pale pink in southern New England but in the neighborhood of the White Mountains *Cypripedium acaule* Ait. f. *albiflorum* Rand & Redfield becomes so common as actually to replace it in certain areas.¹

For the paler colors found in *Hepatica acutiloba* and in other species in New England as compared with the Ozarks, and for the greater frequencies of albinos in the vicinity of the White Mountains, one might offer two quite different explanations. Both depend upon the fact that the New England forests are denser and shadier than the upland forests of the Ozarks and that within New England they become progressively shadier towards the mountains, culminating in the deep shade of the spruce forests of that region. By the first explanation the paler-flowered forms would be the direct result of generations of existence within this shady environment. Though such an explanation might immediately be advanced by many naturalists, it finds little support in experimental biology. An explanation more fully in accord with the facts of variation and heredity is that in this case, as in many others, the environment affects the organism indirectly by selection. In the deep woods, as at dusk, white flowers are more conspicuous than colored ones. In the full blaze of the sun they are less so. Selection, therefore, operates differently in the two environments, and from the same basic stocks produces bright-flowered races in the sunny Ozark woodlands and white-flowered and pale-tinted ones in the shadier New England forests.

MISSOURI BOTANICAL GARDEN.

ASPLENIUM PLATYNEURON (L.) OAKES, VAR. **bacculum-rubrum** (Featherman), comb. nov. *A. ebeneum*, var. *Bacculum Rubrum* Featherman, Rep. Bot. Surv. So. Centr. La. 1870: 75 (1871). *A. platyneuron*, var. *euroaustrium* Fernald in RHODORA, xxxvii. 382, pl. 384, figs. 1 and 2 (1935).

Mr. Weatherby unkindly calls my attention to the publication of the variety of Americus Featherman, whose plant (as the name was intended to indicate) came from near Baton Rouge. There seems to be no question that Featherman had the large extreme with discrete sori described by me.—M. L. FERNALD.

¹ Pease, A. S. Proc. Bost. Soc. Nat. Hist. 37: 216. 1924.